

CLAIMS

1. A method of repeating an inspection of a surface of interest with an inspection system including a control unit coupled to a camera, the method comprising acts of:

5 providing a sequence of camera control parameters corresponding to first inspection data of the surface of interest from the control unit to the camera; and acquiring at least one second inspection data of the surface of interest according to the sequence of camera control parameters.

10 2. The method of claim 1, wherein the act of providing the sequence of camera control parameters includes an act of providing a sequence of camera control parameters having resulted at least in part from manually acquiring a first sequence of images of the surface of interest.

15 3. The method of claim 1, wherein the act of providing the sequence of camera control parameters includes an act of providing a sequence of camera control parameters having resulted at least in part from operator programming.

20 4. The method of claim 1, wherein the act of acquiring at least one second inspection data of the surface includes an act of acquiring an inspection sequence of images of the surface of interest.

25 5. The method of claim 4, wherein the sequence of camera control parameters includes a plurality of sets of camera control parameters, each set of camera control parameters defining at least one pose of the camera.

6. The method of claim 5, wherein the act of acquiring an inspection sequence of images includes an act of acquiring at least one image from each pose of the camera defined by the plurality of sets of camera control parameters.

7. The method of claim 6, wherein each set of camera control parameters includes a value related to at least one of a pan action, a tilt action, a zoom and a position.

5 8. The method of claim 5, further comprising an act of mounting the camera at a reference location having a known position relative to the surface of interest.

9. The method of claim 8, wherein the act of applying the sequence of camera control parameters includes an act of applying the sequence of camera control 10 parameters such that each set of camera control parameters is an offset from the reference location.

10. The method of claim 8, wherein the act of applying the sequence of camera control parameters includes an act of applying the sequence of camera control 15 parameters such that each set of camera control parameters is an offset from an immediately preceding pose of the camera.

11. The method of claim 1, further comprising an act of obtaining the sequence of camera control parameters from a computer readable medium.

20 12. An inspection apparatus adapted to automatically acquire inspection data of a surface of interest, the apparatus comprising:

data collection equipment including a camera capable of acquiring at least one image of the surface of interest; and

25 a control unit coupled to the data collection equipment, the control unit configured to provide a sequence of camera control parameters corresponding to first inspection data of the surface of interest to the camera to acquire at least one second inspection data of the surface of interest.

30 13. The method of claim 12, wherein the sequence of camera control parameters result at least in part from acquiring a first sequence of images of the surface of interest.

14. The method of claim 12, wherein the sequence of camera control parameters result at least in part from operator programming.

5 15. The method of claim 12, wherein the at least one second inspection data includes an inspection sequence of images of the surface of interest.

10 16. The apparatus of claim 15, wherein the sequence of camera control parameters includes a plurality of sets of camera control parameters, each set of camera control parameters defining a pose of the camera such that the inspection sequence of images includes at least one image acquired from each pose defined by the plurality of sets of camera control parameters.

15 17. The apparatus of claim 16, wherein each set of camera control parameters includes a value for at least one of a pan action, a tilt action, a zoom action, and a position.

20 18. The inspection apparatus of claim 12, wherein the camera is a video camera.

19. The inspection apparatus of claim 18, wherein the video camera has at least two degrees of freedom.

25 20. The inspection apparatus of claim 18, wherein the video camera has at least four degrees of freedom.

21. The inspection apparatus of claim 18, wherein the video camera has at least six degrees of freedom.

30 22. The inspection apparatus of claim 15, wherein the control unit comprises a computer having a memory for storing at least one sequence of camera control parameters.

23. The inspection apparatus of claim 22, wherein the memory is encoded with at least one program configured to automatically analyze the inspection sequence of images to detect the presence or absence of subject matter of interest in each image in the sequence.

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24. The inspection apparatus of claim 23, wherein the at least one program automatically analyzes the inspection sequence of images by distinguishing subject matter of interest from the image content by at least one of color analysis, edge analysis and shape analysis.

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25. The inspection apparatus of claim 24, wherein the at least one program provides an inspection result of the surface of interest.

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26. The inspection apparatus of claim 22, further comprising a video recorder coupled to the video camera and the computer, the video recorder adapted to receive video data from the video camera and to provide image information based on the video data to the computer.

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27. The inspection apparatus of claim 26, wherein when the inspection system is operating on the sequence of camera control parameters the video data includes an inspection sequence of images of the surface of interest and the image information includes a digital inspection sequence of images of the surface of interest.

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28. The inspection apparatus of claim 26, further comprising a display coupled to the video recorder for displaying the video data received from the video camera.

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29. The inspection apparatus of claim 28, further comprising an interface device adapted to be controlled by an operator and to provide control signals indicative of operator control.

30. The inspection apparatus of claim 18, in combination with the surface of interest.

31. The combination of claim 30, wherein the surface of interest is an inside 5 surface of a substantially closed volume.

32. The combination of claim 31, wherein the surface of interest is a tank.

33. The combination of claim 31, wherein access to the inside of the volume 10 is permitted through at least one entry point.

34. The combination of claim 33, wherein the data collection equipment further includes a stalk having the video camera coupled to a first end of the stalk, the stalk comprising:

15 means for securing the stalk to the at least one entry point, such that the first end of the stalk is inside the volume.

35. The combination of claim 34, further comprising means for positioning the camera in a known reference position with respect to the volume.

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36. The inspection apparatus of claim 12, wherein the data collection equipment is adapted to be submersed in a fluid.

25 37. The inspection apparatus of claim 36, wherein the data collection equipment includes locomotion means adapted to navigate the data collection equipment through the fluid.

38. A method of inspecting a surface of interest, the method comprising acts 30 of:

automatically applying a sequence of camera control parameters to acquire a sequence of images of the surface of interest; and

automatically processing the sequence of images to evaluate the surface of interest to provide an inspection result.

39. The method of claim 38, wherein the act of applying the sequence of
5 camera control parameters includes an act of applying a sequence of camera control parameters having resulted at least in part from a manual inspection of the surface of interest.

40. The method of claim 38, wherein the act of applying the sequence of
10 camera control parameters includes an act of applying a sequence of camera control parameters having resulted at least in part from operator programming.

41. The method of claim 38, wherein the act of automatically processing the sequence of images includes an act of automatically determining the amount of subject matter of interest present in the sequence of images.
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42. The method of claim 41, wherein the act of automatically determining the amount of subject matter of interest includes an act of automatically detecting characteristic features of the subject matter of interest.
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43. The method of claim 42, wherein the act of automatically detecting characteristic features of the subject matter of interest includes an act of automatically detecting edge characteristics of the subject matter of interest.

44. The method of claim 43, wherein that act of automatically detecting edge characteristics includes an act of automatically detecting edge characteristics based on at least one of edge strength, edge cluster size, and edge cluster eccentricity.
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45. The method of claim 44, wherein the act of automatically detecting edge characteristics includes an act of evaluating an edge cluster based on at least one of the mean greyscale value of the edge cluster and the standard deviation of the greyscale values of the edge cluster.
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46. An automated inspection apparatus comprising:
means for automatically acquiring at least one sequence of images of a surface of
interest from a sequence of camera control parameters; and
5 means for automatically processing the at least one sequence of images to
automatically evaluate the surface of interest to provide an inspection result.

47. The automated inspection system of claim 46, wherein the means for
automatically acquiring at least one sequence comprises:
10 a video camera;
a processor coupled to the video camera via communications means; and
a memory accessible by the processor having stored thereon a sequence of
camera control parameters associated with a plurality of poses of the camera that when
applied to the camera by the processor results in the at least one sequence of images.
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48. The automated inspection system of claim 46, wherein the means for
automatically processing the at least one sequence of images includes a processor and a
memory accessible by the processor having encoded thereon at least one program that
when executed by the processor assesses each image in the at least one sequence of
20 images such that the amount of subject matter of interest in each image is determined.